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Tagging inflorescence method: An Antixenosis mechanism of resistance against Pigeon Pea pod borer, *Helicoverpa armigera*

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Abstract
Twenty six germplasms of pigeonpea screened for their resistance/tolerance to pod borer *Helicoverpa armigera* under natural infestation in pesticides free open field for two consecutive years. *Helicoverpa armigera* is one of the most important pests of pigeonpea, and plant resistance is an important component for minimizing the extent of losses caused by this pest. Therefore, to develop insect-resistant cultivars, we studied the antixenosis mechanism of resistance to *H. armigera* in a diverse array of pigeonpea germplasms under tagging inflorescence method. Tagging inflorescence an antixenosis mechanism was tested in case of 26 germplasms under field conditions. It was observed that, all the germplasms tested were found moderate to low resistance to *H. armigera, none* of them was found free from infestation of the pest. Among the germplasms tested PT-0012 recorded highest number of pods followed by Bahar. Lowest pod per 25 cm inflorescence was recorded in JKM-07. The germplasms developed by the local research station Badanapur, BDN-2003-1, BDN-2001-9 and BDN-708 was found superior with PT-0012, ICPL-332, ICPL-84060 WRG-53, BSMR-853 and AKT-8811 in case of per cent pod damaged, larval survival and lower larval weight than other germplasms. Germplasm JKM-207 recorded highest pod damage, larval survival and larval weight by *H. armigera.*

Keywords: *Helicoverpa armigera*, antixenosis, pigeonpea, resistance mechanisms

Introduction

Among the pulses production in India pigeonpea, *Cajanus cajan* (L.) Millsp. is one of the major grain legumes after gram crop. Due to heavy damage caused by insect pests productivity of pigeonpea has remained static over the past several decades. More than 200 insect species feed on this crop, of which the pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera : Noctuidae) is the most damaging pests worldwide. At times, it causes complete crop loss (Shanower *et al*., 1999) [9, 19]. *H. armigera* has been reported to cause loss of US$ 325 million annually (ICRISAT, 1992) [3]. *H. armigera* damage is particularly severe in the medium-maturity cultivars grown in India. In pigeonpea, one larva per plant reduces 4.95 green pods, 7.03 dry pods and 18.01 grain per plant (Meenakshi Sundaram and Gujar, 1998) [8]. Sahoo and Senapati (2000) [16] revealed that a yield loss of 27.77 and 14.28 kg/ha was obtained for each unit increase in larval population and for every unit per cent increase in pod damage, due to the pod borer complex. To overcome these losses farmers resort to excessive use of pesticides.

A number of pigeonpea genotypes have been reported to be resistant to *H. armigera* (Lateef and Pimbert, 1990; Sharma *et al*., 2001) [6, 21]. Pod damage was lowest in the short duration cultivars and highest in the long duration cultivars Rao *et al.* (2003) [14]. Pest susceptible rating (PSR) showed that the genotype ICP 8863 suffered the highest pod damage caused by LPBs, while the lowest was in KM 124 and KM 125 (Srivastava and Mohapatra, 2002) [23]. Lateef and Pimbert (1990) [7] screened the entire ICRISAT pigeonpea collection of more than 14,000 pigeonpea accessions for reaction against pod borer. Several genotypes were identified which consistently suffered lower pod damage. Hence, it is important to characterize different sources of resistance for expression of antixenosis component of resistance to *H. armigera* under tagging inflorescence method to develop appropriate strategies to breed for resistance to this pest. Therefore, we studied the antixenosis component of resistance to *H. armigera* in a diverse array of pigeonpea genotypes under laboratory conditions.

Materials and Methods

Twenty six pigeonpea cultivars were screened in thrice replicated trial. The germplasms were sown in field condition and tested in laboratory condition for their resistance /tolerance to various germplasms in tagging inflorescence method of an antixenosis mechanism against *H. armigera*. The screening was followed at Vasantrao Naik Marathwada Agricultural University, Parbhani. Each germplasm was sown in two rows of each 10 m length with a spacing 60 cm x 30 cm by dibbling method. All the recommended agronomic practices were adopted to raise the crop. Studies were carried out in field at the time of 50 per cent pod formation stage of pigeonpea germplasms for testing tagging inflorescence method against *H. armigera*.

1. **Tagging inflorescence method:** Five inflorescence per line of the test materials (25cm inflorescence) were tagged including susceptible and resistance checks (similar maturity group) at 50 per cent pod formation stage and covered with brown bag after releasing three 3rd instar larvae per inflorescence and on fifth day number of damaged and undamaged pods were counted and per cent pod damage by *H. armigera* calculated as well as larval survival and larval weight were also recorded.
2. **Statistical analysis:** The data obtained from the laboratory experiment was done by completely randomized design as per the methods described in "Statistical Methods for Agricultural Workers" by Panse and Sukhatme (1985) for determining the relative susceptibility of pigeonpea germplasms.
   Appropriate standard error (S.E.) and critical differences (C.D.) at 5% level were worked out as and when necessary and used for data interpretation.

Result and Discussion

Pods per 25 cm. inflorescence

All the 26 germplasms tested revealed significant differences of pooled data in pods per 25 cm inflorescence. Among the germplasms tested PT-0012 recorded highest number of pods per 25cm long inflorescence i.e. 35.18 pods followed by Bahar i.e. 34.71 pods. The local check BSMR-853 recorded 16.63 pods per 25 cm long inflorescence followed by PT-332, JKM-207, C-11 and VRG-l in the range of 16.40 to 14.59 pods per 25 cm inflorescence.

Damaged pods

The observations on damaged pods were recorded on fifth day from the release of three larvae per 25 cm long inflorescence. Lowest number of damaged pods was observed in BDN-708 i.e. 4.86 and was at par with ICPL-332 and the local check BSMR-853 which was showed significant difference over all the treatments. The highest number of damage pods was observed in BSMR-736 i.e. 12.73.

However the interaction of both the year showed significant difference.

Per cent pod Damage

The per cent pod damage by tagging inflorescence method was found significant among the germplasms. As per pooled data lowest per cent pod damage was recorded in BDN-2001-9 (34.73%) which was at par with BDN-2003-1 with 36.42 per cent followed by the group of PT-0012 (36.75%), ICPL-332 (36.97%), BDN-708 (37.28%), ICPL-84060 (38.22%) and local check, BSMR-853 recorded pod damage i.e. 38.78 per cent. Remaining all the germplasms recorded more damage than the local check, BSMR-853 in ranged from 39.18 per cent in WRG-53 to 49.18 per cent in WRG-51.

In present study not a single germplasm was completely free from the infestation of *H. armigera.* The results supported by Patel and Patel (1990) [11]. ICRISAT (1992) [3] reported variety ICPL-332 as tolerant to the pod borer *H. armigera* and was having on an average 35 per cent borer damaged pods as against the cultivars C-1 1 (51 % borer damaged pods). C-l1 was having 17.2 per cent pod damage due to *H. armigera* reported by Sahoo and Patnaik (1993) [4] and also reported that none of the extra early genotype was free from infestation by major species of borer (Raut *et al.* 1993; Mali and Patil, 1994) [16]. Minja *et al.* (1999) [20] reported pod borers damaged seeds in all genotypes. A total of 2033 accessions of pigeonpea screened against pod borer for three years indicated that the varieties of ICRISAT showed lower levels of pod damage compared with the control variety Bahar (Lal and Rathore, 1999; Rao and Mohammad, 1999; Venkateswarlu and Singh, 1999) [5, 14, 25]. Medium duration variety C-l1 was recorded 54.09 per cent pod damage and early maturing variety showed maximum damage 57.07 per cent, reported by Sahoo and Senapati (2001) [17]. Cultivars C-l1, ICPL-87119, WRG-47 and WRG-53 showed more damage due to pests compared to the other cultivars, BSMR-846, AKT-9726 was reported by Surana *et al.* (2002) [24]. Sharma *et al.* (2003) [18] revealed that all the genotypes tested showed low level of resistance.

Larval Survival

According to the data the lowest larval survival was observed in the germplasms BDN-2003- 1 (1.07) followed the next group includes BDN -2004 (1.33), BDN -2001-9 (1.40) and BDN-2009 (1.46), which were at par with each other and significantly superior over all remaining germplasms. The germplasms PT-909 and LRG-41 were recorded 1.56 larva per plant and were significantly superior over BDN-708 (1.76). The local check BSMR-853 recorded 1.93 larva/plant followed by ICPL-84060 (1.93) and PT-11-39-1 (2.07) and recorded significantly superior difference over remaining all germplasms ranged from 2.13 larva/plant in PT-0012 to 3.00 larva / plant in JKM- 207.

Similar results have earlier been reported by Shanower *et al.* (1997) [20].

Larval weight at release

The third instar larva of *H. armigera* released on tagged inflorescence of 25 cm at 50 per cent pod formation stage in tagging inflorescence method for recording the observation on survival and growth of *H. armigera* larva on fifth day from release by releasing three larvae per 25 cm inflorescence. The larval weight recorded at the time of release in the pooled data indicated non-significant results. The larval weight ranged from 0.090 to 0.091g.

Larval weight on 5th day

Significant differences were recorded on larval weight on 5th day from larval release in tagging inflorescence method. Pooled data revealed the lowest larval weight 0.119g observed in BDN-2001-9 followed by BDN-2003-1 (0.121g), ICPL-84060 (0.123g), ICPL-332 (0.126g), BDN-708 (0.12Sg) and PT-0012 (0.129g), which were at par with each other and significantly superior over next group WRG-53 (0.127g), BSMR-853 (0.129g) and Bahar (0.129g). Remaining all the germplasms recorded larval weight ranged from 0.131g in AKT-8811 to 0.143g in JKM-207.

Similar observations are made by Dodia and Patel (1994) [1], who indicated that a significant decline in larval weights were observed for larvae fed on developing pods of resistant varieties, ICPL-270 and ICPL-84060 as compared to those fed on the susceptible variety, BDN-2 (Sison and Shanower, 1994 and Dodia *et al.*1996) [22, 2]. No significant differences were observed in the larval weight gain by *H. armigera* feeding on different plant parts reported by Rao (2000) [12], Thus the results of present investigation are is conformity with results of earlier workers

Table 1: Pooled data on number of pod and damaged pods per 25 cm long inflorescence and per cent pod damaged by *H. armigera* to different germplasms.

Sr. No.	Germplasms	Pooled observations recorded on 5th day after release of three larva/ 25cm inflorescence		
		No. of pods/25 cm	No. of damaged pods	Per cent pod damaged
1	WRG-55	16.31	7.87	48.56
2	ICPL-87119	20.42	9.00	44.15
3	BDN-2010	18.41	8.94	48.71
4	JKM-207	15.98	7.97	40.35
5	VRG-1	14.59	7.10	48.58
6	C-11	14.60	6.67	48.04
7	ICPL-84060	23.95	9.13	38.22
8	BDN-708	17.54	6.60	37.28
9	BDN-2001-9	18.68	6.47	34.73
10	AKT-9929	33.61	13.80	41.42
11	BDN-2003-1	27.84	10,10	36.42
12	PT-332	16.40	10.30	44.53
13	Bahar	34.71	14.00	40.56
14	PT-0012	25.19	12.90	36.75
15	ICPL-332	19.71	7.27	36.97
16	BSMR-736	30.74	14.43	47.15
17	BSMR-846	21.34	10.67	50.40
18	PT-909	32.71	13.83	42.59
19	WRG-53	31.72	12.37	39.18
20	AKT-8811	25.90	10,13	39.37
21	WRG-51	19.54	9.53	49.18
22	LRG-41	26.65	10.83	40.94
23	BDN-2009	20.77	9.27	44.98
24	BDN-2004	25.90	11.87	46.09
25	PT-11-39-1	18.99	8.67	45.96
26	BSMR-853	16.63	6.37	38.78
	SE ± CD at 5%	0.145 0.421	0.094 0.273	0.643 1.779

Table 2: Pooled data on Larval survival, weight of larva at release and weight on 5th day after release of larva of *H. armigera* to different germplasms.

Sr. No.	Germplasms	Pooled observations recorded on 5th day after release of three larva/ 25cm inflorescence		
		No. of larva survived	Weight of larva at release	Weight on 5th day after release
1	WRG-55	2.83	0.091	0.144
2	ICPL-87119	2.97	0.090	0.136
3	BDN-2010	2.43	0.090	0.147
4	JKM-207	3.00	0.090	0.146
5	VRG-1	2.67	0.091	0.146
6	C-11	2.53	0.090	0.137
7	ICPL-84060	1.92	0.091	0.118
8	BDN-708	1.76	0.091	0.120
9	BDN-2001-9	1.40	0.091	0.115
10	AKT-9929	2.43	0.090	0.130
11	BDN-2003-1	1.07	0.091	0.117
12	PT-332	2.63	0.091	0.133
13	Bahar	2.66	0.090	0.125
14	PT-0012	2.13	0.090	0.122
15	ICPL-332	2.60	0.090	0.120
16	BSMR-736	2.93	0.091	0.143
17	BSMR-846	2.63	0.090	0.142
18	PT-909	1.56	0.091	0.130
19	WRG-53	2.90	0.091	0.122
20	AKT-8811	2.49	0.091	0.127
21	WRG-51	2.93	0.091	0.140
22	LRG-41	1.56	0.090	0.128
23	BDN-2009	1.46	0.090	0.134
24	BDN-2004	1.33	0.091	0.139
25	PT-11-39-1	2.07	0.091	0.137
26	BSMR-853	1.93	0.091	0.124
	SE ± CD at 5%	0.064 0.176	NS	0.002 0.006

Conclusion

In tagging inflorescence method of an antixenosis mechanism, the number of pods, per cent pod damage, larval survival and larval weight per 25cm long inflorescence were recorded. Maximum 34.71 pods per 25 cm inflorescence were observed in Bahar and minimum 14.59 pods in VRG-1. Lowest pod damage by the *H. armigera* was observed in BDN-2001-9 i.e. 34.73 per cent and highest in WRG-61 i.e. 49.18 per cent. Larval survival was observed from 1.07 larva in BDN-2003-1 to 3.00 in JKM-207 and larval weight of *H. armigera* larva on 5th day from release of three third instar larva per 25cm inflorescence was ranged from 0.115g in BDN-2001-9 to 0.147g in BDN-2010. The germplasms BDN-2001-9, BDN-708, BDN-2003-1, PT-0012, ICPL-332, ICPL-84060, WRG-53, BSMR-853 and AKT-8811 were recorded less pod damage and lower larval weight than other germplasms.

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